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Structure and diversity of bovine breeds in Patagonia verde

Carvajal, A.M.[1@]; Martínez, M.E.[2] and De la Barra, R.[1]

[1]Instituto de Investigaciones Agropecuarias, INIA Remehue. Osorno. Chile.
[2]Instituto de Investigaciones Agropecuarias, INIA Butalcura, Castro. Chile.

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SUMMARY

Patagonia Verde is a territory of southern Chile shaped by a harsh climate and geography that highlights the requirement of highly rustic and well adapted cattle biotypes. Historically, Hereford and crossbreeding with Overo Colorado were used for breeding purposes but without progeny evaluations. The status of the herds and their purity are currently unknown. Thus, cattle and breed characterization are needed to breeding schemes. The aim of this study was to obtain information about distribution and structure of the cattle breeds in Patagonia Verde. The identification of breeds was carried out by direct observation of each animal and its racial descriptors. Animals of all ages and of both sexes were included, and those poorly differentiated or mixtures of different biotypes were classified as hybrids. A hierarchical agglomerative clustering analysis was performed in order to identify patterns in the herd structure. ANOVA and Fisher LSD tests were carried out to identify mean differences (P<0.05) in relation to the representation of each biotype and cluster. 233 herds and a total of 2,713 cattle heads were counted. The largest number of heads was recorded in Palena but the average herd size showed no differences between the communes. Regarding the biotypes, Hereford (24%) and Overo Colorado (18%) showed the highest frequency but we found a high frequency (37%) of hybrids throughout the territory. The herds formed four groupings (C1-C4), with C1 and C2 being the largest. They accounted for 95% of the total and were distributed through the territory but without a clear territorial differentiation of racial biotypes.

Estructura y diversidad de razas bovinas en Patagonia verde

Palabras clave
Bovino.
Patagonia verde.
Razas.

RESUMEN

Patagonia Verde (PV) corresponde a un territorio del sur de Chile moldeado por un clima y geografía agrestes que hacen patente el requerimiento de biotipos bovinos muy bien adaptados. Tradicionalmente se han utilizado como reproductores bovinos Hereford y cruzas con Overo Colorado, pero sin realizarse evaluaciones genéticas de la progenie. Por tanto, en miras de establecer un programa de mejoramiento se requiere conocer el estado de los rebaños en términos de su pureza racial. El objetivo de este trabajo fue obtener información acerca de la distribución y estructura de los rebaños bovinos presentes en PV. La identificación de los biotipos o razas se realizó mediante observación directa de cada animal evaluando sus descriptores raciales. Se incluyeron animales de cualquier edad y sexo, y aquellos pobremente diferenciados o con mezclas en sus descriptores fueron clasificados como híbridos. El análisis y caracterización de los rebaños se realizó mediante clusterización aglomerativa jerárquica de forma de identificar patrones en la estructura de rebaño. La composición de cada clúster fue analizada mediante estadística descriptiva y las diferencias entre los biotipos y su distribución mediante ANOVA y test de Fisher LSD (p<0,05). Se contabilizaron 233 rebaños y un total de 2.713 animales. El mayor número de animales se contabilizó en Palena, pero sin diferencias en el tamaño promedio de los rebaños entre las comunas. Los biotipos más frecuentes fueron Hereford (24%) y Overo Colorado (18%) pero con un alto porcentaje de animales híbridos (37%), mientras que los rebaños formaron cuatro agrupamientos (C1-C4) pero sin una clara diferenciación territorial de los biotipos.

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andres.carvajal@inia.cl

INTRODUCTION

The *Patagonia Verde* (PV) territory encompasses the northernmost area of the Chilean Patagonia, and goes from Cochamó in the north to Palena in the south. Both localities belong to Los Lagos area; this territorial arrangement is also known as continental Chiloé (41°30′00′′S, 72°19′00′′W - 43°00′00′′S, 72°20′00′′O; **Figure 1**). PV is characterized by a particular agroecology, shaped by a harsh climate and geography, where abundant rainfall and moderate to low temperatures predominate in the coastal sectors (Cochamó, Hualaihué and Chaitén), and large variations in temperature and winter snow in the mountain ranges (east of Cochamó, Futaleufú and Palena) are found. These conditions, together with a limited area of pastures, the existence inceptisoils, the isolation and the lack of technology, slow down the agricultural work of family small-scale (Garner and De la O Campos, 2014) and medium-scale farmers that live in the territory, mainly dispersed in rural areas (Sáenz. 2015; Martínez et al. 2018). This scenario greatly contrasts with the prevailing conditions in the rest of the region, which concentrates much of the country's livestock, meat and milk production, based on grazing improved and / or naturalized grasslands (Demanet. 2013; Fernández and Farías. 2019).

Beef farming in PV is mainly based on the grazing of naturalized pastures and the use of preserved forages such as hay, together with some forage resources in high range mountains during the summer season. In

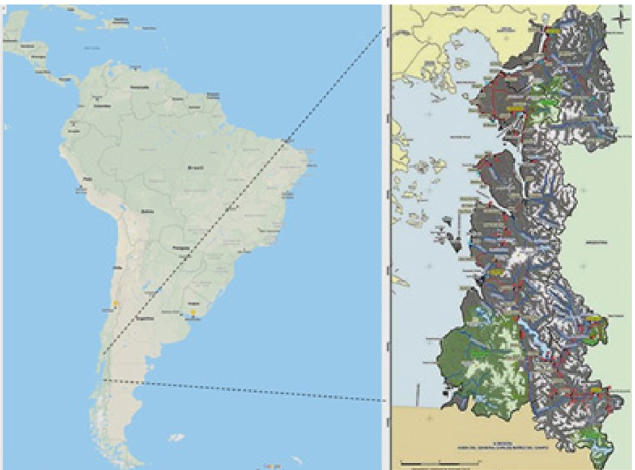

Figure 1. Location of the Patagonia Verde territory, Los Lagos region, Chile (Localización de Patagonia Verde en la región de Los Lagos, Chile).

this context of harsh climate and geographic isolation, conditions are done for the selection of highly rustic cattle, with high adaptive capacity to extreme environmental conditions understanding rusticity as the ability of an individual to overcome the different variations in the environment without affecting production outcomes. Meat-purpose biotypes such as Hereford have been historically introduced mainly with breeding purposes and crossbred with the dual purpose or meat-oriented creole biotypes already existing in the territory such as Overo Colorado, which came from the Llanquihue province from the mid-eighteenth century (De la Barra et al. 2020), but without evaluations of the progeny. The status of the herds and their purity and/or racial standards are currently unknown, with no information on the genetic variability of specimens used as breeders. It is unknown if this scenario may be reducing the productivity of these stocks, and therefore the quality and standards of the products, in addition to some reproductive or sanitary parameters. Thus, cattle and breed characterization are needed to breeding schemes which should seek to obtain best adapted animals to the production environment into which they will be introduced. Therefore, it is important that the information on cattle breed distribution and characterization are made accessible to decision-makers at all levels.

Therefore, it is important to have a description of the distribution and structure of the herds by biotype or breed in the territory, as a first step in establishing a genetic improvement program. The aim of this study was to obtain knowledge of the cattle breeds and biotypes in the *Patagonia Verde* territory, and their current state as distinct breed populations and their distribution at the commune level.

MATERIAL AND METHODS

Cattle herds appearing next to the main and secondary public road network of the five communes that make up the PV territory were directly observed, following transects and using prismatic lenses in order to visualize the individual detail of the biotype of each animal and perform the herd count, as described by De la Barra et al. (2019). The requirement to define a herd to be characterized was the possibility of a full observation, and that the signs of each biotype were fully distinguishable according to their racial descriptors (**Figure 2**). Animals of all ages and of both sexes were included, and those with poorly differentiated traits or mixtures of different biotypes were classified as hybrids.

The analysis and characterization of the observed herds were carried out applying grouping techniques in order to identify patterns in the herd structure. A hierarchical agglomerative clustering analysis was performed. Once the groupings were made, the composition of each cluster was obtained by means of descriptive statistics. Subsequently, an ANOVA and

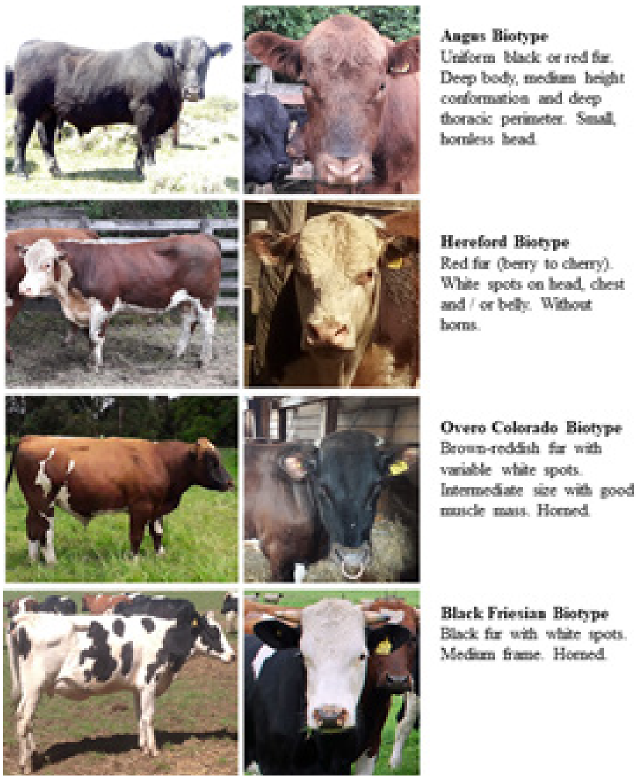

Figure 2. Racial ideotypes used for the identification of biotypes and bovine breeds in Patagonia Verde (Ideotipos raciales utilizados para la identificación de razas bovinas en Patagonia Verde).

a Fisher LSD test were performed to identify average differences and to make comparisons between them, and thus identify whether the representation of each racial biotype and each cluster evidenced significant statistical differences by commune. Statistical analysis was performed with the Xlstat 2016 program and significance was defined using a P<0.05.

RESULTS AND DISCUSSION

Two hundred and thirty-three herds and a total of 2,713 cattle heads were accounted. This numbers are approximately 12.8% of the total cattle stock declared in the last national biannual survey of livestock (INE. 2015). The number of herds and animals per commune is described in **Table I**, observing the largest number of herds in the communes of Palena and Chaitén (72 and 67, respectively), while in Hualaihué and Cochamó a lowest number was observed (30 and 19, respectively). The largest number of heads was recorded in Palena (930), followed by Chaitén and Futaleufú with the same numbers (639). The smallest number of animals was recorded in Hualaihué and Cochamó, with 316 and 189 heads, respectively. Despite these differences in the total count of animals, the average size of the herd did not show significant differences between the communes (p>0.05), differently from the expected result due to the greater livestock vocation of the mountain ranges communes (Palena and Futaleufú) with regard to the coastal communes (Chaitén, Hualaihué and Cochamó), where productive activities are divided between husbandry and fishing. The magnitude of these numbers corroborates that the PV territory is characterized by a small-scale cattle livestock activity, with a reduced number of animals per herd compared to the average values for the region (INE. 2007; Martínez et al. 2018).

The livestock owned by smallholders and pastoralists in PV comes from early introductions of exotic breeds to the area. Meat-purpose biotypes such as Hereford have been historically used; these biotypes have been introduced mainly with breeding purposes. In addition, these exotic biotypes have been crossbred with the dual purpose or meat-oriented creole biotypes already existing in the territory such as Clavel Alemán or Overo Colorado, which came from the Llanquihue province from the mid-eighteenth century (De la Barra et al. 2020). Traditional livestock keepers have no technical training in genetics. However, they possess valuable local knowledge about breeds and their management (Carvajal et al. 2019). They have breeding goals and strategies even if they are not "formalized" or written down. For example, they may share breeding males with their neighbors or the entire community. In these conditions, formalizing genetic improvement is a challenging, but definitely not an impossible task.

Table I. **Number of herds and animal heads observed** (Número de rebaños y cabezas animales observadas).

Variable	Palena	Futaleufú	Chaitén	Hualaihué	Cochamó
Herd numbers	72 (30,9)	45 (19,3)	67 (28,8)	30 (12,9)	19 (8,2)
Average herd size	12,91 ^{a}	14,20 ^{a}	9,54 ^{a}	10,53 ^{a}	9,95 ^{a}
Total heads	930	639	639	316	189

In parentheses, % of total herds. Different letters within a row indicate statistically significant differences (p <0.05).

Genetic improvement at PV is justified, but under their conditions it should be achieved by crossbreeding, instead of straight breeding. Intervention to reduce environmental stresses (supplementary feeding, parasite treatments or other management inputs) is often unaffordable. Implementing a straight-breeding program is a long-term undertaking, requiring considerable resources, good organization, and most of all, commitment of all stakeholders. These requirements tend to be lacking under low-input systems and existing programs has a limited scope. Cross-breeding with an exotic breed may appear to be a more rapid way to improve performance with a minimal increase of inputs. However, the higher performance of the cross-breeds is accompanied by higher nutritional and management requirements (disease control, housing, etc.). Therefore, any system that incorporates higher-performing crossbred animals will require -among other needs- more feed resources which in many cases can only be achieved by maintaining a smaller number of animals.

Regarding the identified biotypes or breeds, the analysis showed significant differences by commune, highlighting the high frequency of presentation of hybrid animals throughout the territory (37.3%; **Table II**). This corroborates the report by Pizarro et al. (2009) based on genetic analysis of population structure in southern Chile. In our study, the percentage of hybrids ranged from 21.8% in Hualaihué to 50% in Palena and Futaleufú, with intermediate values for Cochamó and Chaitén. In other words, the most isolated communes showed greater hybridization than those closest and most accessible to the region's populated centers. This could be the result of the inability to locally generate purebred bulls, and/or the difficulty of acquiring them outside the territory, due to the higher cost and the logistical difficulties for the importation. In this regard, it has to be noted that the artificial insemination technologies are not used in PV, due to the absence of breeding stations and the low presence of trained professionals. By this time, some isolated initiatives have been carried out, with relative success so far. On the other hand, Chilean legal regulations indicate that the introduction of cattle into the territory must come from areas and farms which are free from bovine brucellosis (SAG. 2011). In this scenario, it is likely that the incorporation of some breeding males will be favored, but not the replacement females. Data from the last survey (INE. 2015) indicate that the main investment effort was put into the improvement of the pastures, and not the acquisition of replacement cows. This would prevent the formation of racial nuclei of breeders that supply the requirements of local producers, and, therefore, products (progeny) with homogeneous values and standards (Segura-Correa and Montes-Pérez. 2001). At the same time, this situation could be generating an increase in inbreeding, especially in the maternal line, which could favor the loss of adaptive, productive and reproductive values of the herds, as well as the expression of undesirable genes in the population (Mc Parland et al. 2007; Schaler et al. 2019).

Up to now, these crossbreeding have been the best tool that PV low input system have to satisfy the productive demands of their herds. However, considering the low orientation or advice regarding this tool, the benefits are only manifested in direct progeny (F1) based on hybrid vigor, and do not spread to subsequent generations. Nevertheless, the benefits of producing meat are often of secondary importance, in these remote areas where cattle contribute to nutrient recycling and serves as savings bank and insurance against natural calamities (Köhler-Rollefson. 2005).

Regarding the pure racial biotypes that could be identified, the Angus, Hereford, Overo Colorado and Black Friesian breeds were observed in the five communes, with different frequencies (**Table II**). The biotypes with the highest observation frequency in the whole territory were Hereford and Overo Colorado (24.2 and 18.0%, respectively), while the Black Frisian was the least (8.0%). The Angus biotype was intermediate, including black and red specimens (12.5%). These results are aligned with the last national biannual survey of livestock (INE, 2015), where most of the animals / biotypes were declared by farmers as Overo Colorado (38.9%) and Hereford (22.7%), Angus with 12.8%, and to a lesser extent the European Overo negro (1.4%). In this survey, only 24.3% of the animals were declared as meat-purpose crossbreeding, that is, hybrid animals. Preliminary data obtained by our group shows that between 66% and 83% of a sample of 42 farmers accurately recognized the main meat breeds in the PV territory, with a small percentage that did not adequately distinguish these biotypes, or did not discern when an animal showed inconsistencies compared to its racial standard (Carvajal et al., 2019). This could affect the differences found in the percentage of hybrid animals declared by the farmers and the observations reported here.

It can also be observed that Hereford cattle are well distributed in the five communes, with a higher presence in Cochamó, while Angus is mainly concentrated in the mountain areas: Palena, Futaleufú and Cochamó (**Table II**). In turn, the Overo Colorado biotype is concentrated to a greater extent in coastal communes such as Chaitén and Hualaihué, while the Black Frisian is mainly in Hualaihué (23.1%). Regarding the Angus biotype, it is interesting to mention that, although the percentage of animals declared in the INE survey (2015) and in our study is consistent, when observing the herds, the red biotype was more frequently identified, especially in the mountains range communes (data not shown). Therefore, its representation could be expected to increase in a medium term. On the other hand, it should be mentioned that very few specimens from other meat breeds such as Limousin, Charolais and Simmental were identified in the communes (less than 0.1%), and practically no dairy biotypes were observed, even known that the Black Friesian has a dual-purpose orientation (milk and meat).

Table II. Frequency of racial biotypes and hybrids as a percentage of the total of each commune (Frecuencia de biotipos raciales e híbridos como porcentaje del total de cada comuna).

Biotypes (%)	Commune					
	Palena	Futaleufú	Chaitén	Hualaihué	Cochamó	Total
Angus	14,4 ^{b}	20,3 ^{a}	5,8 ^{c}	2,2 ^{c}	19,6 ^{a}	12,5
Hereford	12,8 ^{c}	23,9 ^{b}	19,4 ^{b}	26,3 ^{b}	38,6 ^{a}	24,2
Ov. Colorado	17,5 ^{b}	3,4 ^{c}	31,9 ^{a}	26,6 ^{a}	10,6 ^{b,c}	18,0
B. Friesian	5,0 ^{b}	2,0 ^{b}	6,7 ^{b}	23,1 ^{a}	3,1 ^{b}	8,0
Hybrids	50,3 ^{a}	50,2 ^{a}	36,2 ^{b}	21,8 ^{c}	28,0 ^{b,c}	37,3

Different letters within a row indicate statistically significant differences ($p < 0.05$).

The current breed distribution is the result of several initiatives in order to introduce germplasm, mainly by live bulls. For example, between 2003 and 2005 the INIA in collaboration with the INDAP (National Institute of Agricultural Development), carried out the introduction of robust breeds such as Hereford and Aberdeen Angus (Siebald et al. 2011). Nevertheless, no evaluation and / or genetic diversity studies have been carried out so far. These breeds and their crossbreeding products still remain in the area as reflected in our results, and given the level of hybridization observed, it is very likely that the crossings were carried out indiscriminately and without precise productive orientation. The selection and introduction of these breeds corresponds to the search for biotypes of good productive adaptation to the hostile environmental conditions of the territory. In these territories, animal hardiness emerges as a valuable attribute that can be intended and reproduced. This attribute includes the ability to buffer nutritional deficit, adaptation to available foods, rapid recovery of the body score, adequate thermoregulation, adaptation to topography and resistance to infectious and / or parasitic diseases, and is primarily achieved by natural selection, and therefore, the hardiness of the animal and the harsh environment are correlated. PV is an extensive and mountain range environment, wild and inhospitable (Iraira et al. 2017), where animals eventually activate mechanisms allowing them not only to survive, but also to reproduce and produce with advantage in adverse or variable environments.

In this sense, the Overo Colorado has been recognized as a rustic animal with good adaptability in PV, with high resistance to grazing on low quality forages, to walking long distances on stony soils and to some diseases (functional traits). However, given the current demands and preferences of the market, and with the aim of increasing the economic return, there is an increasing search for breeds or biotypes that, in addition to being hardy, have also better productive performance, such as Aberdeen Angus which shows better weight gain. Thus, the breeding of red Angus bulls with Overo Colorado cows is being evidenced in the last years.

It is during the winter season where the most important adaptation challenges arise at the PV observing sub-zero temperatures, snow and winds that decrease the thermal sensation, as well as a limited availability of good quality forages to meet the nutritional requirements of livestock. Farmers often have limited access to external inputs and to commodity markets, and there are usually limited resources available for their purchase. For such a low-input system, it is inadequate to think of genetic improvement only in terms of increases in output traits, such as body weight. Efficiency is also a key criterion. Unfortunately, very little is known about the genetic improvement of intrinsic efficiency. Increased efficiency is usually measured in terms of increased gross efficiency. This parameter observed in high producing animals results from the fact that a lower proportion of the animals' nutrient intake is used for maintenance, and a correspondingly higher proportion is used for production. This does not mean that the animal needs less feed to achieve a given level of performance. Selection based on residual feed intake (RFI) has been proposed as a way of improving intrinsic efficiency. This is an important criterion for all species and all production systems. Genetic and genomic selection to reduce RFI can result in animals that eat less without sacrificing growth or production performance (Hegarty et al. 2007; Hayes et al. 2013; Kenny et al. 2018). For example, in contrast to the ratio of weight gain/feed intake, residual feed consumption is relatively independent of growth, and it is therefore a more sensitive and precise measurement of feed utilization (Cantalapiedra-Hijar et al. 2018).

A common tendency in research related to breeding programs for all species is an increasing focus on functional traits (e.g. robustness, disease resistance and, fertility, efficiency of feed utilization, etc.) – in response to the growing importance given to factors such as animal welfare, environmental protection, distinctive product qualities and human health (Hayes et al. 2013). Functional traits are of great importance in low-input systems. Recording of functional traits, however, still remains an important bottleneck that hinders their inclusion in breeding schemes. In PV, there is no information regarding the genetic basis of disease resistance, welfare, hardiness and adaptation to different environments. The dairy cattle industry has started to use DNA typing of single genes and genomics (SNPs) to screen breeding animals, but this has not been extended to meat purpose cattle yet, where these methodologies are absent from the territory, given the organization of the sector, the reduced access to bulls and the absence of accurate production records. This is unlike other zones of Patagonia like Aysén, where the Angus breeders and holders are associated and undertake commercial activities with the support of public-private instruments, and they are already carrying out objective genetic evaluations (Hepp et al. 2019). This situation supports breeding for functional and lifetime productivity traits in PV. Addressing this opportunity involves challenges of associativity and locally developing breeders with guarantees of genetic quality, health and traceability. For this, the offer of pure breed bulls adapted to the environment must be sophisticated and the focus must be on the conformation of homogeneous stock, as well as the identification and selection of superior animals.

We also determined the structure of the herds in terms of specific groupings of racial biotypes (similar or distinguishable). **Figure 3** shows that the herds formed four groupings (C1, C2, C3 and C4), with C1 and C2 being the majority clusters (with 121 and 101 herds, respectively), accounting for the 95% of the total (**Table III**). These two clusters are present in the five communes, and showed an average herd size of 7.1 and 14.2 animals, respectively, lower values than those observed for C3 and C4 (41.7 and 35.5 respectively). Clusters 1, 2 and 3 group several racial biotypes above 5%, while C4 only showed the Hereford biotype above this percentage, reaching 66.2%. In the other clusters (C1, C2 and C3), only the Overo Colorado biotype reached a significant representation (35%, C1).

At the commune level, cluster C1 represents 31.6% of the herds, with higher distribution in the communes of Palena and Chaitén (**Table IV**), while C2 is mainly concentrated in Palena, Futaleufú and Chaitén (the remote communes), representing 52.4% of the herds. On the other hand, clusters C3 and C4 only appear in three of the communes, with C3 concentrating mainly on Palena, and C4 being distributed in Futaleufú and in a lesser extent in Chaitén and Hualaihué. Both groups are absent from Cochamó. These differences in the distribution of the clusters could suggest a certain degree of preference in the search and / or introduction of specific biotypes by the farmers.

Table III. Characterization of the herd structure in Patagonia Verde (Caracterización de la estructura de rebaños en Patagonia Verde).

Variable	Clúster			
	C1	C2	C3	C4
Herd numbers	121	101	7	4
Average herd size	7,1 ^{c}	14,2 ^{b}	41,7 ^{a}	35,5 ^{a}
Presence in communes	5	5	3	3
Biotypes over 5%	Ov. Colorado Hereford B. Friesian Angus	Angus Hereford Ov. Colorado	Angus Ov. Colorado Hereford	Hereford
Biotypes under 5%	-	B. Friesian	B. Friesian	Angus Ov. Colorado B. Friesian
% of the herd with racial biotypes	83,4 ^{a}	46,3 ^{b}	32,2 ^{b}	76,1 ^{a}
% of the herd with main biotype	35,1 ^{b}	16,6 ^{c}	11,6 ^{c}	66,2 ^{a}

Different letters within a row indicate statistically significant differences (p <0.05).

Table IV. Distribution of the herd structure clusters in the Patagonia Verde territory (values in percentage) (Distribución de agrupamientos de estructura de rebaños en Patagonia Verde (valores en porcentaje)).

Cluster (% of total)	Commune					
	Palena	Futaleufú	Chaitén	Hualaihué	Cochamó	Total
C1	30,1 a	8,9 b	30,1 a	21,4 a	9,5 b	31,6
C2	32,3 a	32,3 a	20,7 a	7,3 b	7,6 b	52,4
C3	74,0 a	14,0 b	12,0 b	0,0	0,0	10,8
C4	0,0	45,1 a	33,8 a,b	21,1 b	0,0	5,2

Different letters within a row indicate statistically significant differences ($p < 0.05$).

Table V. Cluster of the herd structure in the Patagonia Verde territory (values in percentage) (Agrupamientos de la estructura de rebaños en Patagonia Verde (valores en porcentaje)).

Cluster	Biotype (% of total)				
	Angus	Hereford	O. Colorado	B. Friesian	Hybrids
C1	7,3 c	28,2 a,b	35,1 a	12,8 b,c	16,6 b,c
C2	16,6 b	13,8 c	10,8 b,c	5,1 c	53,7 a
C3	11,6 b	6,5 b	10,6 b	3,4 b	67,8 a
C4	4,2 b	66,2 a	4,2 b	1,4 b	23,9 b

Different letters within a row indicate statistically significant differences ($p < 0.05$).

Table V shows that hybrid animals are distributed in all clusters, with differences in their distribution. Hybrid biotype is the main component of the territory biotype structure for clusters C2 and C3, but not for C1 and C4, while pure biotypes are distributed in all clusters. For C4, the predominant biotype was Hereford (66.2%), while for C1 the Hereford and the Overo Colorado biotypes showed the highest representation (28.2 and 35.1%, respectively). Finally, the Angus biotype was the least represented in cluster C1, while the Black Frisian had a frequency of less than 5% in clusters C2, C3 and C4.

In this paper we describe the distribution of beef cattle breeds in PV and we will follow with the genetic characterization in terms of herd racial purity and inbreeding. Animals born and raised in this territory can be characterized by a high hardiness, which will be reflected in adequate weight gain. At the same time, it is important to bear in mind that the environment conditions the genetic expression through epigenetic marks (Goddard and Whitelaw. 2014), which are inheritable. It is interesting that in the areas where these animals are sold (Osorno, Llanquihue and others), beef farming is being strongly pressured by other productive activities (dairy, crops and fruit trees), displacing meat production to rural areas. Therefore, it can be anticipated that in the near future, more rustic bulls will be required so that they produce properly in harder conditions. In this sense, one specific opportunity arises for farmers in PV: to refine their production in order to generate bulls bearing these distinctive hardy characteristics.

CONCLUSIONS

According to the results of the present study, it can be assessed that in the Patagonia Verde, several bovine biotypes are repeated, with an almost exclusive orientation to meat production. The territory is characterized by a small-scale livestock production with small herds, showing a high distribution of hybrid animals not assignable to any racial biotype. However, the predominant cattle breeds are Hereford and Overo Colorado, and an increase in Angus biotype animals is expected in the coming years. Additionally, the herd structure can be grouped into four clusters, two of them with presence in the five communes, without a clear territorial differentiation of racial biotypes.

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